



Strand V: Numerical and Algebraic Operations and Analytical Thinking

Standard I: Operations and their Properties - Students understand and use various types of operations (e.g., addition, subtraction, multiplication, division) to solve problems.

- Key Ideas:
- 1. Understanding the basic computational operations is essential for competence in mathematics, but there is no one way to perform a calculation.
 - 2. Methods of computation include proficiency with mental calculation, paper and pencil, and calculators; students must know which method is most appropriate for a given task.
 - 3. Understanding the operations requires that students also understand the properties of those operations and how to apply them.
 - 4. The ultimate reason for mastering the computational operations and their algorithms is to solve problems.

| Elementary Benchmark | Kindergarten | Grade 1 | Grade 2 | Grade 3 | Grade 4 |
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| 1. Use manipulatives to model operations with numbers; develop their own methods of recording operations; and relate their models and recordings to standard symbolic expressions and algorithms. | Compose and decompose numbers N.MR.00.08 Describe and make drawings to represent situations/stories involving putting together and taking apart for totals up to 10; use finger and object counting. Add and subtract numbers N.MR.00.09 Record mathematical thinking by writing simple addition and subtraction sentences, e.g., $7 + 2 = 9$, $10 - 8 = 2$. | Add and subtract whole numbers N.MR.01.10 Model addition and subtraction for numbers less than 20 for a given contextual situation using objects or pictures; explain in words; record using numbers and symbols; solve. | Add and subtract whole numbers N.MR.02.07 Find the distance between numbers on the number line, e.g., how far is 79 from 26? N.MR.02.09 Given a contextual situation that involves addition and subtraction for numbers up to two digits: model using objects or pictures, explain in words, record using numbers and symbols; solve. Understand meaning of multiplication and division N.MR.02.13 Understand multiplication as the result of counting the total number of objects in a set of equal groups, e.g., 3×5 gives the number of objects in 3 groups of 5 objects, or $3 \times 5 = 5 + 5 + 5 = 15$. N.MR.02.14 Represent multiplication using area and array models. N.MR.02.16 Given a simple situation involving groups of equal size or of sharing equally, represent with objects, words, and symbols; solve. | Multiply and divide whole numbers N.MR.03.10 Recognize situations that can be solved using multiplication and division including finding “How many groups?” and “How many in a group?” and write mathematical statements for those situations. N.MR.03.14 Solve simple division problems involving remainders, viewing remainder as the “number left over” (less than the divisor), e.g., 4 children per group; we have 25 children; there are 6 groups with 1 child left over; interpret based on problem context. | Multiply fractions by whole numbers N.MR.04.30 Multiply fractions by whole numbers, using repeated addition and area or array models. |
| 2. Develop and apply the appropriate method of computation from among mental computation, estimation, paper-and-pencil or calculators; explain why they are choosing a method and how they know which operations to perform in a given situation. | | Add and subtract whole numbers N.FL.01.12 Know all the addition facts up to $10 + 10$, and solve the related subtraction problems fluently. N.FL.01.14 Add three one-digit numbers. N.FL.01.15 Calculate mentally sums and differences involving: a two-digit number and a one-digit number without regrouping; a two-digit number and a multiple of 10. N.FL.01.16 Compute sums and differences up to two-digit numbers using number facts and strategies, but no formal algorithm. | Add and subtract whole numbers N.FL.02.10 Add fluently two numbers up to two digits each, using strategies including formal algorithms; subtract fluently two numbers up to two digits each. N.FL.02.12 Calculate mentally sums and differences involving: three-digit numbers and ones; three-digit numbers and tens; three-digit numbers and hundreds. Understand meaning of multiplication and division N.FL.02.17 Develop strategies for fluently multiplying numbers up to 5×5 . | Add and subtract whole numbers N.FL.03.06 Add and subtract fluently two numbers: up to and including two-digit numbers with regrouping and up to four-digit numbers without regrouping. N.FL.03.07 Estimate the sum and difference of two numbers with three digits (sums up to 1000), and judge reasonableness of estimates. N.FL.03.08 Use mental strategies to fluently add and subtract two-digit numbers. Multiply and divide whole numbers N.FL.03.11 Find products fluently up to 10×10 ; find related quotients using multiplication and division relationships. N.FL.03.13 Mentally calculate simple products and quotients: up to a three-digit number by a one-digit number involving multiples of 10, e.g., 500×6 , or $400 \div 8$. | Add and subtract whole numbers N.FL.04.08 Add and subtract whole numbers fluently. Multiply and divide whole numbers N.ME.04.09 Multiply two-digit numbers by 2, 3, 4, and 5, using the distributive property, e.g., $21 \times 3 = (1 + 20) \times 3 = (1 \times 3) + (20 \times 3) = 3 + 60 = 63$. N.FL.04.10 Multiply fluently any whole number by a one-digit number, and a three-digit number by a two-digit number; for two-digit by one-digit multiplication, use distributive property to develop meaning for the algorithm. N.FL.04.11 Divide numbers up to four-digits by one-digit numbers and by 10. Add and subtract fractions N.MR.04.27 Add and subtract fractions less than 1 with denominators 12 or less and including 100, in cases where the denominators are equal or when one denominator is a multiple of the other; e.g., $\frac{1}{12} + \frac{5}{12} = \frac{6}{12}$; $\frac{2}{25} + \frac{7}{50} = \frac{11}{50}$. |

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| | | | | | <p>N.FL.04.28 Solve fraction problems involving sums and differences for fractions where one denominator is a multiple of the other (denominators 2 through 12, and 100).</p> <p>Add and subtract decimal fractions</p> <p>N.FL.04.32 Add and subtract decimals up to two decimal places.</p> <p>Multiply and divide decimal fractions</p> <p>N.FL.04.33 Multiply and divide decimals up to two decimal places by a one-digit whole number where the result is a terminating decimal, e.g., $0.42 \div 3 = 0.14$, but not $5 \div 3 = 1.\overline{6}$.</p> <p>Estimate</p> <p>N.FL.04.34 Estimate the answers to calculations involving addition, subtraction, or multiplication.</p> <p>N.FL.04.35 Know when approximation is appropriate and use it to check the reasonableness of answers; be familiar with common place-value errors in calculations.</p> <p>N.FL.04.36 Make appropriate estimations and calculations fluently with whole numbers using mental math strategies.</p> |
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| 3. Explore properties of operations (e.g., commutative and distributive properties) and give examples of how they use those properties. | | <p>Explore place value N.ME.01.07 Compose and decompose numbers to 30, including using bundles of tens and units, e.g., recognize 24 as 2 tens and 4 ones, 10 and 10 and 4, 20 and 4, and 24 ones.</p> <p>Add and subtract whole numbers N.MR.01.11 Understand the inverse relationship between addition and subtraction, e.g., subtraction “undoes” addition: if $3 + 5 = 8$, we know that $8 - 3 = 5$ and $8 - 5 = 3$; recognize that some problems involving combining, “taking away”, or comparing can be solved by either operation.</p> <p>Add and subtract whole numbers N.FL.01.12 Know all the addition facts up to $10 + 10$, and solve the related subtraction problems fluently.</p> | <p>Understand place value N.ME.02.05 Express numbers up to 1000 using place value, e.g., 137 is 1 hundred, 3 tens, and 7 ones; use concrete materials.</p> <p>Understand meaning of multiplication and division N.MR.02.15 Understand division (\div) as another way of expressing multiplication, using fact families within the 5×5 multiplication table; emphasize that division “undoes” multiplication, e.g., $2 \times 3 = 6$ can be rewritten as $6 \div 2 = 3$ or $6 \div 3 = 2$.</p> | <p>Understand and use number notation and place value N.ME.03.02 Recognize and use expanded notation for numbers using place value to 10,000s place, e.g., 2,517 is 2 thousands, 5 hundreds, 1 ten, and 7 ones; 4 hundreds and 2 ones is 402; identify the place value of a digit in a number, e.g., in 3,241, 2 is in the hundreds place.</p> <p>Multiply and divide whole numbers N.MR.03.09 Use multiplication and division fact families to understand the inverse relationship of these two operations, e.g., because $3 \times 8 = 24$, we know that $24 \div 8 = 3$ or $24 \div 3 = 8$; express a multiplication statement as an equivalent division statement.</p> | <p>Understand and use number notation and place value N.ME.04.02 Compose and decompose numbers using place value to 1,000,000's, e.g., 25,068 is 2 ten thousands, 5 thousands, 0 hundreds, 6 tens, and 8 ones.</p> <p>Multiply and divide whole numbers N.ME.04.09 Multiply two-digit numbers by 2, 3, 4, and 5, using the distributive property, e.g., $21 \times 3 = (1 + 20) \times 3 = (1 \times 3) + (20 \times 3) = 3 + 60 = 63$.</p> <p>N.FL.04.10 Multiply fluently any whole number by a one-digit number, and a three-digit number by a two-digit number; for two-digit by one-digit multiplication, use distributive property to develop meaning for the algorithm.</p> <p>N.MR.04.13 Use the relationship between multiplication and division to simplify computations and check results.</p> <p>Read, interpret and compare decimal fractions N.ME.04.16 Know that terminating decimals represent fractions whose denominators are 10, 10×10, $10 \times 10 \times 10$, etc. e.g., powers of 10.</p> |
| 4. Apply operations efficiently and accurately in solving problems. | | | | <p>Problem solving with whole numbers N.MR.03.15 Given problems that use any one of the four operations with appropriate numbers, represent with objects, words, (including “product” and “quotient”), and mathematical statements; solve.</p> | <p>Multiply and divide whole numbers N.FL.04.14 Solve applied problems involving whole number multiplication and division.</p> <p>Add and subtract fractions N.FL.04.28 Solve fraction problems involving sums and differences for fractions where one denominator is a multiple of the other (denominators 2 through 12, and 100).</p> <p>Add and subtract decimal fractions N.MR.04.31 Use mathematical statements to represent problems that use addition and subtraction of decimals with up to two-digits; solve.</p> <p>Problem solving N.MR.04.37 Solve applied problems using the four basic arithmetic operations, for appropriate fractions, decimals, and whole numbers.</p> |



Strand V: Numerical and Algebraic Operations and Analytical Thinking

Standard 2: Algebraic and Analytic Thinking - Students analyze problems to determine an appropriate process for solution, and use algebraic notations to model or represent problems.

- Key Ideas:
- 1. Students develop both symbol sense and number sense as they learn to read, write and speak the language of mathematics.
 - 2. Mathematical representations, which may be numerical, literal, symbolic, graphical, pictorial or physical, enable students to visualize and understand problems.
 - 3. Solving mathematical problems involves a process as well as a product; the context of the problem determines the nature of the solution.
 - 4. Students learn analytic thinking most effectively when it is studied in the context of problems and applications.
 - 5. Students employ algebraic and analytic thinking and the power of technology to explore problems that reveal the many ways that mathematics is used in a wide variety of contemporary applications.

| Elementary Benchmark | Kindergarten | Grade 1 | Grade 2 | Grade 3 | Grade 4 |
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| 1. Write and solve open sentences (e.g., $+ = 5$) and write stories to fit the open sentence. | Compose and decompose numbers N.MR.00.08 Describe and make drawings to represent situations/stories involving putting together and taking apart for totals up to 10; use finger and object counting. | Add and subtract whole numbers N.MR.01.13 Apply knowledge of fact families to solve simple open sentences for addition and subtraction, such as: $+ 2 = 7$ and $10 - = 6$. | Add and subtract whole numbers N.MR.02.08 Find missing values in open sentences, e.g., $42 + = 57$; use relationship between addition and subtraction. | Multiply and divide whole numbers N.MR.03.10 Recognize situations that can be solved using multiplication and division including finding “How many groups?” and “How many in a group?” and write mathematical statements for those situations. N.MR.03.12 Find solutions to open sentences, such as $7 \times = 42$ or $12 \div = 4$, using the inverse relationship between multiplication and division. | Multiply and divide whole numbers N.FL.04.12 Find unknowns in equations such as $a \div 10 = 25$; $125 \div b = 25$. |
| 2. Explore algebraic concepts with manipulatives such as balance scales, tables of input and output, and pictorial representations of problems. | | Add and subtract whole numbers N.MR.01.10 Model addition and subtraction for numbers less than 20 for a given contextual situation using objects or pictures; explain in words; record using numbers and symbols; solve. | Add and subtract whole numbers N.MR.02.09 Given a contextual situation that involves addition and subtraction for numbers up to two digits: model using objects or pictures, explain in words, record using numbers and symbols; solve. Create, interpret, and solve problems involving pictographs D.RE.02.01 Make pictographs using a scale representation, using scales where symbols equal more than one. | | |
| 3. Find replacements for the variable(s) in open sentences. | | Add and subtract whole numbers N.MR.01.13 Apply knowledge of fact families to solve simple open sentences for addition and subtraction, such as: $+ 2 = 7$ and $10 - = 6$. | Add and subtract whole numbers N.MR.02.08 Find missing values in open sentences, e.g., $42 + = 57$; use relationship between addition and subtraction. | Multiply and divide whole numbers N.MR.03.12 Find solutions to open sentences, such as $7 \times = 42$ or $12 \div = 4$, using the inverse relationship between multiplication and division. | Multiply and divide whole numbers N.FL.04.12 Find unknowns in equations such as $a \div 10 = 25$; $125 \div b = 25$. N.MR.04.29 Solve for the unknown in equations such as: $\frac{1}{8} + x = \frac{5}{8} \text{ or } \frac{3}{4} - y = \frac{1}{2}$ |
| 4. Use analytic thinking to describe situations and solve problems. | | | | | |
| 5. (Does not apply at the elementary grades.) | | | | | |